

Standard Method of
Determining Longitudinal Surface Smoothness
 (California Type Profilograph)
 FLH Designation: T 504-08
Metric

I. Collection of Data

1. SCOPE

1.1 This test method is used to measure the smoothness of a pavement surface in metric units by using a California type profilograph. The profilograph produces a hard copy trace of the surface, from which deviations in the surface are identified and measured.

2. EQUIPMENT

2.1 *Profilograph* - The profilograph shall be a California type profilograph consisting of a metal frame with multiple wheel trucks supporting each end and a center mounted measuring wheel. The unsupported length between the wheel tracks shall be 7.62 meters. The profilograph shall have steering capability.

NOTE 1 - Insure equipment used is performing properly and is calibrated according to section **3.0 CALIBRATION** of this test procedure or according to the manufacture recommendations.

2.1.1 The profilograph shall be equipped with a graphic recorder capable of recording the distance of travel and the magnitude of vertical variation. The recorder shall have a horizontal scale of 1 millimeter = 0.3 meter, and a vertical scale of 1 millimeter = 1 millimeter.

2.2 *Bump Location Template* - The template shall consist of a piece of transparent plastic at least 130 millimeter long by 75 millimeters wide (See Figure A). A line, parallel to the long side, shall be scribed on the template. This line shall be crossed with 2 perpendicularly scribed lines 25.4 millimeters apart near the center of the template. Construct a straight slot through the template, parallel to the long side and 10.2 millimeters from the first line scribed. The slot shall extend the distance between the perpendicular lines previously scribed. The 25.4-millimeter line corresponds to a longitudinal distance of 7.62 meters on the longitudinal scale of the profilogram. The 10.2 millimeter distance between the parallel lines represents the maximum allowable bump in 7.62 meters.

3.0 CALIBRATION

3.1 *Longitudinal (distance) Calibration* - Check the longitudinal calibration before initial use and at such other times as may be required for verification. Verify tire air pressure, as per manufacture recommendations. Operate the profilograph over a measured test section on a reasonably flat and level surface for 100 meters in length. The length of the test section as measured by the graphic recorder shall be within the following tolerance:

$$\text{Longitudinal calibration} \quad L / L_R = 0.3 \pm 0.0024$$

Where: L = length of test section in meters, (± 10 mm)
 L_R = recorded length of test section in millimeters, (± 1 mm)

3.2 Vertical calibration - Check the vertical calibration before initial use and at such other times as may be required for verification. Keep the profilograph stationary. Using pre-measured calibration blocks measured to the nearest 0.1 millimeter, pull or slide the block(s) under the recording wheel. Measure the vertical trace line from the base line to the peak and return. The trace line must return to the base line. Compare the actual heights of the calibration blocks with the heights of their vertical trace line. These heights should be within ± 1 millimeter.

NOTE 2 - If the longitudinal and vertical calibration checks are not within the allowable tolerances specified, make the appropriate adjustments or repairs.

4.0 PREPARATION

4.1 Establish ground controls on the section of roadway to be tested. Controls should include the beginning and end with sufficient intermediate markers to facilitate correlation of areas on the graphic readout to the actual ground locations.

4.2 Provide for traffic control including appropriate warning signs and flaggers.

4.3 Assemble the instrument at the work site and perform the calibration procedures to assure that the equipment is operating properly.

5.0 TESTING

5.1 After determining that the profilograph is operating properly, move to the beginning point. Lower the measurement wheel, and run the test according to manufacture recommendations.

NOTE 3 - Do not back the instrument while the measuring wheel is on the pavement.

5.2 Profile the center of each lane of the project. Profile continuously from beginning to end of project. Do not break profile at excluded areas.

5.3 Mark landmarks and excluded areas on the profilogram for documentation purposes. Mark the beginning and ending stations and identify the lane (either left or right) and the direction in which the trace is run (either ahead on line or back on line). Mark the trace by making a spike or strum at least 20 millimeters long on the upside of the trace.

NOTE 4 - Interrupting the test to add notes to the profilogram will not interfere with the recording. Locations of physical features along the route such as mile markers, cross drains, bridge ends, guard rail terminals, overhead utility crossings, etc. should be noted on the profilogram. This will aid in matching the ground locations with the graphic record. The trace should be marked and the station identified approximately every 150 meters. Do not write on the trace line. Write notes at least 20 millimeters above or below the line.

5.4 Operate the profilograph at a speed no greater than a normal walk (1 to 5 km/h) to eliminate as much bounce as possible.

NOTE 5 - Asphalt materials may tend to be picked up and build-up on the profilograph wheels causing noticeable chatter on the trace. Wheels need to be cleaned off periodically. Materials pickup on the wheels can be minimized or eliminated by spraying the wheels lightly with WD-40.

II. Profile Trace and Data Reduction

6.1 Determine the smoothness [Profile Index (PrI)] of each 0.1 kilometer section or subplot (N) is by using the ProScan Profilogram Scanning System or an approved equal. The ProScan Profilogram Scanning System is available from:

Surface Systems & Instruments
307 Plymate
Manhattan, KS 66502
(800) 662-5656
<http://www.smoothroad.com/products/proscan/>

6.2 When using the ProScan Profilogram Scanning System it is necessary to set default values for several parameters. The following default values shall be used:

PRI & Scallop Settings	
Blanking Band:	0.00 Millimeters
Minimum Height:	0.900 Millimeters
Minimum Width:	0.61 Meters
Resolution	1.000 Millimeters
Filter	
Filter Type:	Moving Average
Filter Length:	0.610 Meters
Filter Gain:	1.00
Localized Roughness (Bumps)	
Defect Height	10.200 Millimeters
Defect Width	7.6200 Meters

6.3 When using the ProScan Profilogram Scanning System it is necessary to identify and mark the beginning point of the trace. It is also necessary to identify and mark all equations. Mark the trace by drawing a heavy vertical line on the trace at appropriate locations. The vertical line should extend at least 40 millimeters above and below the trace.

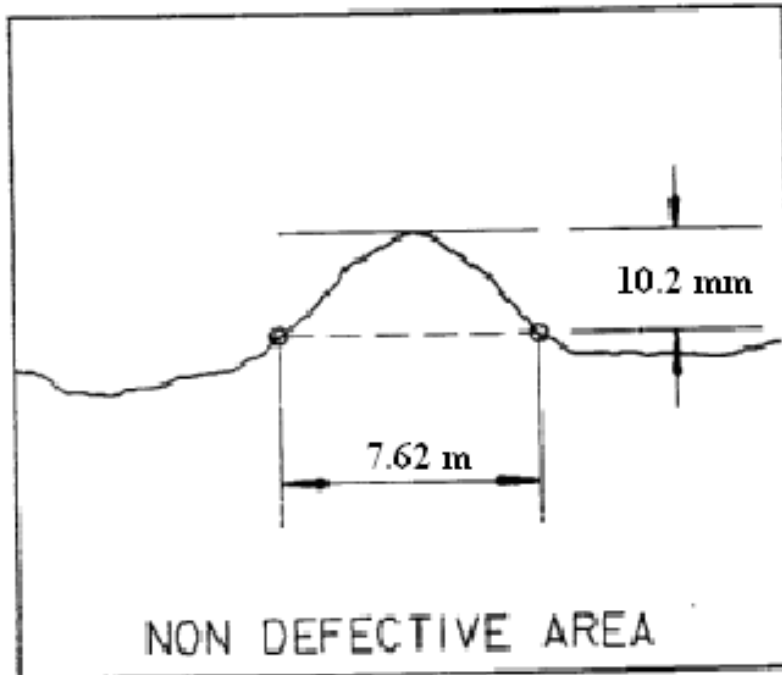
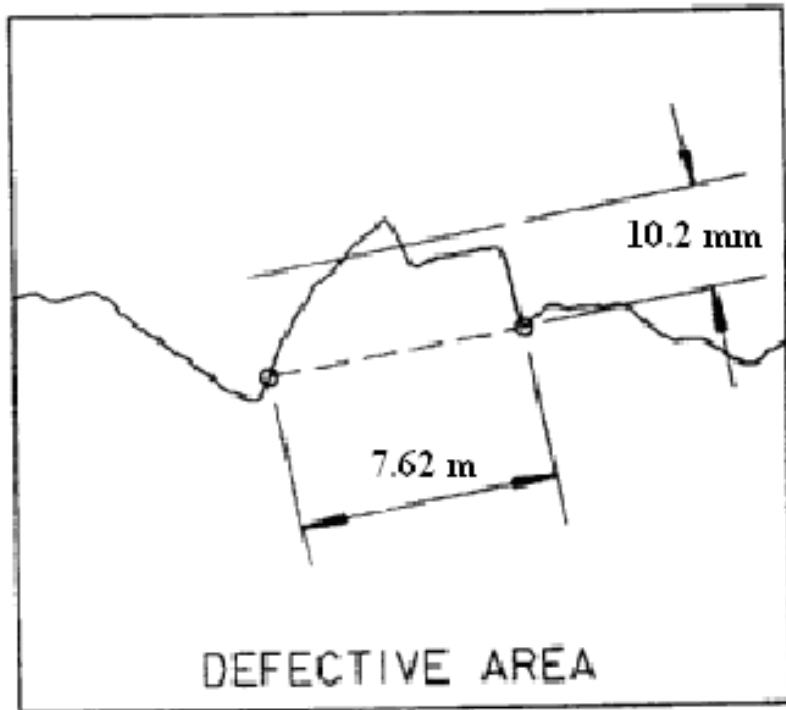
6.4 Scan the trace between marked beginning and ending points. The scanned trace may consist of only one marked segment or it may consist of several segments. Provide the software with appropriate stationing information at all beginning points. When an equation is encountered, provide the software with the appropriate stationing information. Reposition the trace as necessary after reaching an ending point or equation.

6.5 After scanning a trace, print a final report.

6.6 Excluded areas for smoothness and bump determination are:

- 6.6.1** 7.62 meters from bridges
- 6.6.2** Transverse joints with an existing pavement
- 6.6.3** Cattleguards
- 6.6.4** Horizontal curves with less than 150 meters radii
- 6.6.5** Miscellaneous paved areas such as driveways, parking areas, turning or passing lanes (less than 0.1 kilometer), and side roads

Figure A



Scale:

Horizontal 25.4 mm = 7.62 m

Vertical 10.2 mm = 10.2 mm